THE THERAPEUTIC USES OF EXERCISE.

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Reprinted from the Montreal Medical Journal, February, 1894.

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In a recent lecture Dr. Wm. Osler told a popular audience that a desire to take medicine is the great feature that distinguishes man from the other animals, and he went on to say that instead of relying on "a tablespoonful three times a day," he should pay more attention to the principles of hygiene and their application.

Investigation has brought to light new facts from which laws have been formulated. The vital processes are becoming better understood, and diet, heat, cold, rest and exercise, have supplanted to a great extent the exclusive treatment by drugs of most forms of disease. The prescription of drugs is becoming largely supplementary to these other and more important agents. "As a physician advances in age," said the late Sir Andrew Clarke, "he generally places less confidence in the ordinary medicinal treatment than he did, not only during his early but even during his middle period of life." The modern doctor does not as often attempt to perform what Voltaire wittily defined as the miracle of reconciling health with intemperance.

The marvellous progress of the comparatively new science of Bacteriology has directed the attention of the medical world to the importance of preventing the dissemination of disease germs by the agency of earth, air or water. Experiments have shown the tenacity to life of the tubercle bacillus, its life, history and most favorite soil. May we not, in our eagerness to destroy these insinuating sources of disease, by methods which are too

* Read before the Montreal Clinical Society, November. 1893.

apt to include the patient in a common fate, be apt to neglect the best preventative we have, best because the most under our control; I refer to the rearing of a strong and healthy army of phagocytes begotten of good food, sufficient rest, and plenty of exercise.

The most fertile soil for the insidious microbe, is a puny and debilitated organism in which the life processes are slow and feeble; on the other hand if there be strength and activity, disease will not obtain its first foothold or even if it has already entered the body, will be attacked and speedily ejected from a system ready and able to combat such a danger to its well-being. "The physician is only the servant of nature; not its master." He can give the most favourable conditions but the healing power of nature does the rest. Fixity to a broken limb while repair goes on. Rest to the stomach while the ulcer heals. Extra nourishment or stimulants till the system again takes up its accustomed work.

It is along these lines that progress has been made in the past, and will be made in the future, rather than by the discovery of the Elixer of Life, the search for which has occupied so many great minds even to the present day. This search however, may be productive of as great good to humanity as was that for the philosopher's stone whose magic touch was to turn everything to gold. From that vain dream the science of Chemistry received its greatest impulse and may not the equally fantastic search for this life-giving compound incidentally reveal the great physiological laws that govern the life processes? So with increased knowledge we may determine the *proportions* of water, food and exercise, the three ingredients of the true *elixer vitae.*

"He who eats without taking exercise cannot be well," said Hippocrates nearly four hundred years before Christ, and his statement of the case has not been improved upon or refuted since. Galen merely restated the same truth when he said: "The greatest danger to health results from complete inactivity, in the same manner the greatest benefit results from moderate exercise." It is this one Therapeutic agent in its various applications that I would take up for discussion.

The body has been looked upon by many, in fact by most of the medical profession as a chemical compound, and disease has been treated by the administration of chemical substances to restore the stability of the compound. This view of the body has been held almost to the exclusion of its other aspects and the natural reaction has swung the pendulum of thought into the mazes of Psychical research. Schools have sprung up in which disease is looked upon as a mental state. Healing is to be accomplished by faith, accompanied by the laying on of hands, bottled electricity or infinitesimal globules. The body is the expression of the soul, which controls its workings absolutely, so that disease is merely the imperfect expression of the spiritual element in man.

Another view of the body sees it as a complex machine, tolerating a good deal of interference and abuse with comparative impunity, with this advantage over the ordinary machine that it always tends to repair injuries to itself. It has within it the capacity of self-renewal as well as that of dissolution and unlike any other mechanism, the more it is used within physiological limits the better will it work, and the longer will it last.

Bodily movements are among the most potent measures that keep the human machinery in working order. The active use of the various muscle masses affects more than their own tissues. There is pressure on the abdominal contents, stretching of contracted chest walls, and removal of excess of blood from the head and torso out to the periphery where it circulates in the extremities.

A brief resume of the principal effects of exercise would perhaps express the idea I have in mind with greater clearness.

The two-fold function of muscular tissue is to be noted. Each muscle acts as a reservoir for blood, and also as a means for producing heat and motion. Exercise acts as a stimulant to the heart, and "every active muscle," says Weir Mitchell in his book on Fat and Blood, "is practically a throbbing heart squeezing its vessels empty when in motion and relaxing to allow them to fill anew. Thus both for itself and in its relation to the rest of the body its activity is functionally of service."

"The vessels unaided by change of posture and by motion lose tone, . . . so that defects of nutrition occur and with these defects of temperature."

There is a physiological law, known as the Law of Treveranus its discoverer, which may be briefly stated thus:—Each organ is to every other as an excreting organ." In other words to ensure perfect health, every tissue, bone, nerve, tendon or muscle should take from the blood certain materials and return to it certain others. To do this every organ must have its period of activity and of rest so as to keep the vital fluid in a proper state to nourish every other part. This process in perfect health is a system of mutual assurance and is probably essential to a condition of entire vigour of both mind and body. The excretory organ that we most persistently neglect is the skin, extra work is thus put on the intestinal and renal systems with the consequence that they are overworked and become diseased.

The skin is stimulated to increased excretion, most fully and naturally by the various forms of physical exercise. By the term physical exercise, I would include passive as well as active movements; from massage in which the will power of the patient plays no part whatever to the most complicated and delicate voluntary movements in which the training is more for the nerve centres than for the muscles.

In massage the tissues of the body are exercised by the operator for a therapeutic purpose by stroking or rubbing, kneading, pinching, rolling and beating the muscle masses and through them the underlying organs. "By these means are the muscles exercised without the use of volition or the aid of the nervous centres, while increasing mechanically the flow of blood to the tissues which they feed."

In duplicate movements, the will power of the patient is used in resisting or performing under resistance, movements of flexion, extension, circumduction, etc. These movements also require an operator, but Dr. A. Zander has invented a series of machines by which flexions, rotations, vibrations, etc., can be administered without the necessity of an operator. An institu-

tion in which these machines form the exclusive treatment has been founded in New York.

Simple active movements are made without either assistance or resistance. The simple and duplicate movements together with the various positions have been grouped and classified and named in the Swedish medical gymnastics.

The word "exercise," as usually employed would include only light and heavy gymnastics, walking and athletics.

In light gymnastics, movements are arranged in series with perhaps light dumbells or clubs. Muscular developement is quickly produced by these movements. Archibald MacLaren, of Oxford, found while training a squad of officers as instructors to the British Army, that "the muscular additions to the arms and shoulders, and the expansion of the chest, were so great as to have been absolutely ridiculous and embarrassing, for before the fourth month several of the men could not get into their uniforms, jackets and tunics without assistance. In a month more they could not get into them at all. One gained five inches in chest girth." In this connection it may be well to state the fact that in most leg movements the body acts as a heavy weight, and the exercise is as severe as if a hundred pound dumbell were attached to the foot the patient being on his back.

The use of fixed apparatus for suspension and support, horizontal and parallel bars, introduces another principle into gymnastics. The extremities are made the fixed points and the origin of the muscle is thus made its insertion. An application of the principle is well shown in the system of pully weight developing machines, worked out so fully by Dr. Sargent, of Harvard. By them, isolated groups of muscles can be exercised in such a way that by varying the weights used, the dose can be accurately measured and governed. The machines can be adapted to the strength of the strong, or the weakness of the weak, that the greatest benefit may be obtained without the danger of overstraining.

The value of athletic sports as a therapeutic agent is questionable or a least very limited. The competitive element and the

danger of strain and over-exertion would make them rather too drastic to be much used in this way by the physician. But there is an exercise that might be classed as athletic, the one nearly always prescribed by physicians, I refer to walking.

As usually taken, a walk does not exercise the muscles vigorously enough to produce very much effect. The skin is not stimulated sufficiently to act as an excretory organ, and the man comes in dull, heavy and tired out, instead of having the bright warm sensation of strength that is felt after a half hour of brisk hard work, followed by a rub down. The great advantage claimed for walking, is the open air ; that is good, but a shorter time given to more vigorous and more evenly distributed work will give better results.

There are three effects of exercise that would commend it as a therapeutic agent.

1st. It relieves congestions by equalizing the circulation.

2nd. It acts as a sedative to the nervous system probably through its action on the circulation.

3rd. It strengthens and enlarges muscles, bones, and ligaments, and would thus apply to all conditions caused by weakness or inequality of developement.

If the education of a child could be begun as suggested by Oliver Wendell Holmes, 100 years before its birth, there would probably be no necessity for the application of exercise in therapeutics and even now its necessity will be greatly lessened by incorporating exercise in our educational systems. By the gymnastic games of the Kindergarten, children are made strong and healthy from an early age and troubles arising from weakness or malnutrition are prevented.

In schools where systematic physical training has gone hand in hand with mental throughout all grades, the marked improvment in the physique of the children is sufficient to commend such training to all who have the welfare of the race at heart. This improvement will not be universal however until there is as much attention paid to the proper breeding and rearing of children, as there is to that of horses and dogs.

The good effect of a course of exercise on even confirmed

criminals has been studied by Dr. Wey, of the Elmira Reformatory. He says :—" The stimulation of the physical powers a year ago in the case of three impressed their mental organization to a degree that enabled them to earn their release upon parole, whereas if left to themselves their minds would never have been quickened as a reflex of an improved physical state."

The late Dr. Seguin, by the systematic training of the hand and eye gave understanding to an idiot brain and Dr. Luther Gulick reports three cases in which feeble minded children have been made bright, intelligent and active by a course of special exercises calling into active use the will and attention.

Organic disease of the heart has long been treated by the Swedish movement cure, and Oertal of Munich has established an institution in which diet and exercise are the chief agents used. " The heart being a muscle, should be developed in the usual way ;" if it be weak he advises walking on the level and then hill-climbing. The patient should walk till violent palpitation is brought on. He then is required to stand still till that has abated and until the shortness of breadth is satisfied by voluntary long deep inspirations.

Oertel treats in this way even those who have not sufficient compensation, and repeats the treatment at intervals, according to his judgment. This he couples with baths and a diet rich in albumen, preceding it by a course of Swedish gymnastics and baths. Frantz claims that the ventricles can be more completely and efficiently emptied by exercise than by digitalis, and that the benefit is more lasting.

In cases of infantile paralysis, exercise in conjunction with electricity has given satisfactory results in both increased size and usefulness of the groups of muscles affected.

The importance of movements in the treatment of sprains is sometimes overlooked. In speaking of this in his book on that subject, Mansell Moullin says : " The sooner movement is begun the better. As a rule passive movement may be commenced from the second day with the certainty of preventing adhesions. I have repeatedly seen the most severe cases treated in this way recover so completely in the course of a few days that unless

there is an exceptional amount of walking to be done the patient could follow his ordinary occupation without danger and without pain."

Constipation is most amenable to treatment by movements and exercise. Negative evidence on this point is seen in every hospital ward where the daily notes show complete inactivity of the bowels in nearly every case following rest in bed. May not its frequency in women and those of a sedentary occupation be due to this cause? In no other condition is the power of massage so quickly or so surely seen. Swaying movements and flexions of the trunk are natural forms of massage for the abdomenal contents; even in deep breathing the intermittant pressure of the draphragm and abdominal muscles is a physiological massage.

In chronic dyspepsi[illegible]cise is one of the best means of treatment. In one c[illegible] came under my notice lately, half an hour, three times a [illegible] was quite sufficient to relieve the most distressing symptoms. The patient like many another is accustomed to eat more than he uses and without this work the unused nourishment acts as a burden on the system, and even as a direct poison. The following experiment shows the effect of certain movements on the stomach. With feet fixed, body lying supine raise the trunk upright by contracting the abdominal muscles and the flexors of the thigh. If repeated very often a sensation of nausea will be produced in most people, even to the extent of causing vomiting. If such a powerful effect can be produced by a simple movement repeated often, surely less violent or less prolonged action could be used to obtain a therapeutic effect.

In speaking of obesity and its cure Blaikie remarks, "While the spare man may be benefited by a course of moderate gymnastics the corpulent man must," and he cites the case of a man who in five months reduced his weight 90 lbs., from 305 to 215 by exercise alone.

The accumulation of fat in the muscles of the abdominal wall makes them weak, and the tendency to use them as little as possible becomes confirmed.

The burning out of this superabundant fat is best accomplished by the voluntary use of these muscles in movements often repeated and graduated in violence to suit the special case. The loss of weight during muscular exercise is much more considerable than one is apt to realize.

In a two mile race I have known of a man losing nearly two pounds; quite a difference for ten minutes; and in a recent prize fight the difference in weight before and after, in one of the contestants, was seven ponnds.

To be most efficient, a dry diet, rich in albumen, should be combined with gymnastic exercise and walking.

From a series of measurements made by Dr. Geo. H. Taylor, it was found that the average expansion in consumptives was about an inch in place of the normal two or three. He claims that the tendency to pulmonary affections is in the inverse ratio to the amount of respiratory power.

In a recent case of my own, an increase of $3\frac{3}{4}$ inches in a man 21 years of age was found after five month's work, and this is by no means exceptional or even above the ordinary. In another case, after special movements, practiced for a month, the increase in expansive power or chest mobility was $1\frac{1}{2}$ inches, while the method of breathing was much improved, and this with an expenditure of half an hour three times a week. Suppose that at each respiration one cubic inch of air were added by proper breathing, the result would be an increase of 15 cubic feet of air used to oxygenate the blood every twenty-four hours. That is well within the mark.

May it not be that in the search for a specific we are overlooking the natural method of controlling pulmonary tuberculosis and that we are unable to understand the language of nature because it is so simple.

In children who have poorly developed chests with hereditary tendencies toward tuberculosis, a course of special exercises would be valuable, conducted somewhat as follows. Take careful measurements of the chest and extremities, strength tests, lung capacity, heart and respiration. With this data in mind, give a course designed to act more particularly on the respira-

tory system, deep breathing with special exercise for the external respiratory muscles, correct positions in standing, walking and sitting. Repeat the tests every month or two, and at the end of a course, the patient can go back to the physician with the progress shown in black figures, which are worth a dozen opinions.

By carrying on work in this way, facts would accumulate, general rules would shape themselves, and the whole question would be put on a firm scientific basis very different from the disjointed results and inaccurate observations it has had so often in the past.

Wm. A. Edwards advises massage and movement in chorea. He says : If the child be violent it should be held supine upon a mattress for 10 or 15 minutes, while a masseur applies gentle strokings with the palms over the entire body, gradually increasing the time to an hour, repeated every three days. In a short time passive movements, added to overcome tension of antagonistic muscles, and in from eight to ten days voluntary movements, next week gymnastic exercises should be introduced, simple in form, combined with simple voluntary movements of the limbs and trunk. The patient should imitate the movements of the masseur, so as to exercise the will power ; rhythmic movements, timed by music, are of inestimable value for the exercise of the child's will and brain. . . . . The case requires much kindness, persuasion and encouragement. Blache states that of 108 cases of chorea in childhood treated as above, not one relapsed.

Almost every surgeon who has investigated the subject of lateral curvature of the spine, has endeavoured by a theory, differing from that of his predecessors to account for three almost constant facts :—1. Rotation of the vertebræ. 2. Convexity of the dorsal curve to the right, and the lumbar to the left. 3. 90 per cent. of cases are in girls.

Lonsdale, beside mentioning debility and faulty habits of dress, lays great stress on the greater expansion of the right lung and the solid resistance of the underlying liver as being a cause of rotation of the ribs.

Barwell put the blame on the exaggerated use of the right serratus magnus, as well as faulty position and the carrying of weights by the right arm and shoulder. Brodhurst attaches great importance to stays and corsets as a cause. Other causes mentioned are spastic contraction, paralysis of muscles, weight of the heart on the left side, debility etc. All unite however in believing that one of the main causes, apart from those purely mechanical, such as shortening of one leg, old empyema or pleurisy; is muscular debility, inducing faulty positions of sitting and standing. The causes given are many, but the number of methods of treatment is what Dr. Osler would term "suspiciously large." Division of the erectores spinal muscles, has been practised with disastrous results. Mechanical appliances of all degrees of complexity and rigidity have been designed, forcible extension, recumbancy, the prone position, slings and sloping seats, have had their innings, elastic jackets have been worn, while massage, calesthenics and gymnastics have been used with varying degrees of success.

Before any treatment can be accurately tested certain measurements and tests should be made to give a starting point and enable the surgeon to check off his results. Lateral deviation of the spinous processes at various levels, rotation of the ribs and lumbar vertibrae; flexibility in rotation should be ascertained.

The difficulties in the way of getting accurate measurements are great, but graphic tracings first described by Dr. Seaver, by means of an adaptation of the pantograph may be obtained which are perhaps more accurate than any means that I have as yet seen designed. By this means cross sections of the body at different levels can be obtained showing the rotation at these levels. Lateral deviation is shown in such a way that a glance will show its amount at any level.

Flexibility in rotation from side to side can be measured by a graduated half circle placed on the sternum registering the amount of lateral twisting to right and left.

By taking these with other set data, and repeating from time to time, progress under any system of treatment could be determined with comparative accuracy.

The treatment would vary with the case, but certain broad lines have been laid down by Bernard Roth, who published in 1885, (British Medical Journal), his results in a series of 200 consecutive cases. The main feature of his treatment is the discarding of all mechanical supports and the strengthening of the spinal muscles by special exercises. He corrects faulty positions in sitting and standing, uses manipulation and duplicate movements in the corrected position with free gymnastics daily, all directed to equalize the developement of the spinal muscles and improve the general muscular system. Under this treatment the general health is found to improve, pain ceases, and the maximum of improvement possible is attained in from three to six months of daily treatment, lasting about three quarters of an hour, followed by rest supine of ten minutes.

This course of treatment is followed by a home prescription to be taken for a year to ensure permanence of the improvement, He says :—" The conscientious carrying out of this treatment for about one hour daily will enable surgeons to cure or improve the vast majority of cases of lateral curvature of the spine on an average in three months from the commencement of the treatment."

The object of this paper is merely to indicate in outline as briefly as possible the place that exercise should occupy in medicine. In doing so, many things, important perhaps, have had to be left out or barely noticed. In a paper of this length which has to cover such an enormous field, one can but touch upon, without dipping into, a few of the most important principles.

These notes are like a skeleton which the hearer must clothe for himself, with its sinews, muscles, nerves, and vessels, and skin, before he can appreciate the fulness of its outlines. If I have succeeded in stimulating an interest in this department of medicine, too often left to the ignorant empiricist, the quack and professional rubber, I shall feel that I have my reward.